

REMARKS

The present application was filed on March 31, 2004 with claims 1-23. Claims 24-26 were added in a Preliminary Amendment filed on June 28, 2004. Claims 1-26 were subject to a restriction requirement in an Office Action dated April 4, 2005. In the outstanding Office Action dated July 13, 2005, the Examiner has: (i) objected to claims 9 and 10; (ii) rejected claims 1, 3-5 and 12-17 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent Application Publication No. US2002/0053699 to Kim et al. (hereinafter “Kim”); (iii) rejected claims 2, 7-11, 18 and 19 under 35 U.S.C. §103(a) as being unpatentable over Kim, in view of U.S. Patent No. 6,084,264 to Darwish (hereinafter “Darwish”); and (iv) rejected claim 6 under §103(a) as being unpatentable over Kim, in view of Applicant’s admitted prior art.

In this response, claims 20-26 have been canceled without prejudice as being drawn to a non-elected invention. Furthermore, claims 1 and 9 have been amended. Applicants traverse the §102 and §103 rejections for at least the reasons set forth below. Applicants respectfully request reconsideration of the present application in view of the above amendments and the following remarks.

Claims 9 and 10 have been objected to by the Examiner based on informalities. In particular, the Examiner contends that claim 9 should depend from claim 7 or 8. Applicants have amended claim 9 to depend from claim 7 in order to correct an error of a typographical nature. The amendment to claim 9 is believed to address the Examiner’s objection. Accordingly, Applicants respectfully request withdrawal of the objection to claims 9 and 10.

Claims 1, 3-5 and 12-17 stand rejected under §102 as being anticipated by Kim. With regard to independent claim 1, the Examiner contends that Kim discloses all of the elements set forth in this claim. Applicants respectfully disagree with this contention. Kim is directed to a high-frequency power device having a low-resistance sink formed through a thermal anneal process at low temperature (Kim; paragraph [0012]). With particular reference to FIGS. 4A and 4B, the device disclosed by Kim includes one or more trenches (35) formed in an epitaxy layer (32) of the device (Kim; paragraph [0035]). The one or more trenches are used to form a P⁻ sinker (37) in the power device (Kim; paragraph [0036]).

In contrast to the present invention, however, Kim does not teach a step of forming at least one diffusion region between a bottom wall of the trench and the substrate and a separate step of doping one or more sidewalls of the trench with an impurity to thereby form a low-resistance electrical path between the substrate and an upper surface of the epitaxial layer. Rather, Kim teaches doping sidewalls and a lower part of the trench using a source of Boron ion to form a P⁻ doping layer (36a) on the sidewalls and lower part of the trench (Kim; paragraph [0037]). The Examiner appears to analogize the formation of the P⁻ doping layer on the lower part of the trench in the Kim device with the formation of the at least one diffusion region recited in claim 1 when, in fact, the step of forming the at least one diffusion region is separate and distinct from the step of doping at least one or more side walls of the at least one trench. As such, the method taught by Kim and the method set forth in claim 1 are distinguishable from one another.

Notwithstanding the above traversal, claim 1 has been amended in a manner which is believed to further clarify the distinguishing features of the claimed invention. Specifically, claim 1, as amended, requires that “the step of doping at least one or more sidewalls of the at least one trench is performed after the step of forming the at least one diffusion region.” The prior art fails to teach or suggest at least this feature of the claimed invention. Support for this amendment may be found, for example, in the present specification, on page 9, lines 9-26, and in FIGS. 4 and 5 of the drawings. Forming the at least one diffusion region and doping at least one or more sidewalls of the at least one trench as separate and distinct steps advantageously enables the respective thicknesses of the diffusion region and the resulting doping layer surrounding the at least one trench to be formed different relative to one another. Moreover, unlike the method disclosed in Kim, the types and/or concentration levels of the impurity (or impurities) used in forming the diffusion region and in doping at least one or more sidewalls of the at least one trench can be independently controlled in accordance with the methodology of claim 1.

For at least the reasons set forth above, Applicants submit that claim 1 is believed to be patentable over the prior art. Accordingly, favorable reconsideration and allowance of claim 1 is respectfully solicited.

With regard to claims 3-5 and 12-17, which depend from claim 1, Applicants assert that these claims are also patentable over the prior art of record by virtue of their dependency from claim 1,

which is believed to be patentable for at least the reasons given above. Furthermore, one or more of these claims define additional patentable subject matter in their own right. Accordingly, favorable reconsideration and allowance of claims 3-5 and 12-17 are respectfully requested.

Claims 2, 7-11, 18 and 19 stand rejected under §103(a) as being unpatentable over Kim, in view of Darwish. The Examiner acknowledges that Kim “does not disclose implanting boron to form the diffusion region nor cleaning the sidewalls of the trench, nor growing an impurity-rich [oxide] on the trench sidewalls, nor the trench parameters” (Office Action; page 3, paragraph 3). However, the Examiner contends that Darwish teaches such features. Applicants respectfully disagree with this contention.

With regard to claims 2, 7-11, 18 and 19, which depend from claim 1, Applicants assert that these claims are patentable over the prior art of record by virtue of their dependency from claim 1, which is believed to be patentable for at least the reasons given above. Furthermore, one or more of these claims define additional patentable subject matter in their own right. For example, claim 2 further defines the step of forming the at least one diffusion region as comprising the steps of “implanting the bottom wall of the at least one trench with a second impurity of a known concentration level; and driving in the second impurity so as to substantially distribute the second impurity between the bottom wall of the at least one trench and the substrate” (emphasis added).

As previously stated, since the steps of forming the at least one diffusion region and doping at least one or more sidewalls of the at least one trench are performed independently of one another, the type of impurity (first impurity) used in the doping step may be different from the type of impurity (second impurity) used in the formation of the at least one diffusion region. Kim and Darwish, when considered either individually or in combination, fail to disclose at least this additional feature of the claimed invention.

For at least the reasons given above, Applicants submit that claims 2, 7-11, 18 and 19 are patentable over the prior art of record, not merely by virtue of their dependency from claim 1, but also in their own right. Accordingly, favorable reconsideration and allowance of these claims are respectfully requested.

Claim 6 stands rejected under §103(a) as being unpatentable over Kim, in view of Applicant’s admitted prior art. The Examiner acknowledges that Kim fails to disclose that the at

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least one trench comprises a v-groove (Office Action; page 4, paragraph 2). However, the Examiner contends that Applicant's admitted prior art teaches that v-grooves or trenches may be formed when forming a semiconductor structure with an epitaxial layer. While Applicants respectfully disagree with this contention, Applicants submit that claim 6, which depends from claim 1, is also patentable over the prior art by virtue of its dependency from claim 1, which is believed to be patentable for at least the reasons set forth above. Accordingly, favorable reconsideration and allowance of claim 6 are respectfully solicited.

In view of the foregoing, Applicants believe that pending claims 1-19 are in condition for allowance, and respectfully request withdrawal of the §102 and §103 rejections.

Respectfully submitted,



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Wayne L. Ellenbogen
Attorney for Applicant(s)
Reg. No. 43,602
Ryan, Mason & Lewis, LLP
90 Forest Avenue
Locust Valley, NY 11560
(516) 759-7662